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Title of the Invention

Prober Device

Abstract

Object: To obtain a prober device which makes it possible to appropriately maintain a contact pressure between a probe stylus and a wafer evenly by positioning a chuck top for securing the wafer and a probe card in parallel with each other with high precision, and consequently to prolong the service life of the device.

Constitution: A chuck top 7 is provided with a plurality of laser oscillators 21, half mirrors 22, 23, a total reflection mirror 24 and a counter 25. A probe card 1 is provided with a total reflection mirror 26 having a round shape. A prober reference washer 3 has a stepping motor 28 for adjusting the height of the washer 3 and a taper pin 27. Control means 29 calculates the distance between the chuck top 7 and prober card 1 at each point from each piece of information by the counter 25, and sends correction data to the stepping motor 28 so as to make the chuck top 7 and the probe card 1 in parallel with each other with high precision.

Claim

1. A prober device comprising:

a chuck top, where a wafer on which a chip containing integrated semiconductor element is formed is mounted on an upper surface thereof, capable of shifting three dimensionally;

a probe card which is placed above the chuck top;

an inspection member which is placed on the lower surface of the probe card and which brings in contact with a terminal of the chip to test the chip when the chuck top is elevated; and

a securing member which secures the probe card through screws, wherein

the prober device further comprises:

adjusting means for adjusting parallelism of the probe card with respect to the chuck top;

measuring means for measuring the parallelism; and

control means for driving the adjusting means on the basis of an output of the measuring means.

Detailed Description of the Invention

[0001]

Technical Field of the Invention

The present invention relates to a prober device which tests a chip on a wafer prior to a dicing process, and more particularly to a device which brings a bonding pad of each chip in contact with a probe stylus with an even pressure.

[0002]

Prior Art

Fig. 7 is a schematic perspective view which shows a structure of a conventional prober device. In this Figure, reference numeral 1 represents a probe card, 2 represents a probe stylus which is an inspection member

secured to the probe card 1, 3 represents a prober reference washer which serves as a securing member for securing the probe card 1, 4 represents a wafer, 5a and 5b represent chips placed on the wafer 4, that include integrated semiconductor elements. Reference numerals 6a and 6b represent bonding pads which are terminals of the chips 5a and 5b, 7 represents a chuck top which secures the wafer 4 on the upper face 7a thereof, and 8 is a stopping screw which is used for securing the probe card 1 on the prober reference washer 3. Fig. 8 is an enlarged drawing which shows a contact state between the probe stylus 2 and the bonding pad 6. Moreover, another probe card 1A is proposed in which, as shown in Fig. 9, an electrode 9 which is an inspection subject member is directly made in contact with the bonding pad 6 without using the probe stylus 2.

[0003]

The following description will discuss operations of the device. The chuck top 7 which has the wafer 4 which is vacuum-sucked onto its upper surface 7a is allowed to shift three-dimensionally by a stepping motor or the like. After a probe card 1 has been secured on the prober reference washer 3 with stopping screws 8, the chuck top 7 is shifted within a plane in such a manner that a bonding pad 6a on the chip 5a is positioned right under the probe stylus 2. Next, the chuck top 7 is raised so as to make the bonding pad 6a in contact with the probe stylus 2. In this case, an overdriving operation is applied in such a degree that the probe stylus 2 is slightly distorted. A wafer test of the chip 5a is carried out in this state, and upon completion of the test, the chuck top 7 is lowered to its original position, and then shifted to an adjacent chip 5b. Thus, in the same manner as the chip

5a, the bonding pad 6a is made in contact with the probe stylus 2. By repeating the above-mentioned processes, the chip tests are carried out with respect to all the chips on the wafer 4. Here, since the parallelism between the probe card 1 and the chuck top 7 is maintained through the screws fastened to the prober reference washer 3 of the probe card 1, it is not adjusted with high precision with the probe card 1 being attached to the chuck top 7 in a tilted manner, with the result that the contact pressure between the stylus point and the bonding pad might not be maintained evenly with respect to all the styluses. For this reason, the tilt error is absorbed by elasticity of the overdriven stylus.

[0004]

Problems to be Solved by the Invention

In the conventional prober device which has the above-mentioned arrangement, when the overdriving operation is carried out with the probe card 1 being tilted, an uneven load is imposed on each of the individual probe styluses 2, with the result that the shape of the stylus is changed due to an excessive force applied thereto, causing a short service life. Moreover, in the case of the probe card shown in Fig. 9, since it has an integrated structure in which the electrode 9 is directly formed on the probe card 1 without using the probe stylus 2, it is not possible to carry out the overdriving operation since the elasticity of the stylus is not expected because of its structure, and the wafer test sometimes becomes inoperable.

[0005]

The present invention has been devised to solve the above-mentioned problems, and an object thereof is to provide a prober device which makes it

possible to control the parallelism of the probe card with respect to the chuck top with high precision, to maintain the contact pressure between the inspection member such as the probe stylus and the chip terminal evenly in an appropriate manner, and consequently to provide a longer service life in the device.

[0006]

Means to Solve the Problems

A prober device according to the present invention comprises: a chuck top, where a wafer on which a chip containing integrated semiconductor element is formed is mounted on an upper surface thereof, capable of shifting three dimensionally; a probe card which is placed above the chuck top; an inspection member (probe stylus 2, electrode 9) which is placed on the lower surface of the probe card and which brings in contact with a terminal (bonding pads 6a, 6b) of the chip to test the chip when the chuck top is elevated; and a securing member (prober reference washer 3) which secures the probe card through screws, wherein the prober device further comprises: adjusting means for adjusting parallelism of the probe card with respect to the chuck top; measuring means for measuring the parallelism; and control means for driving the adjusting means on the basis of an output of the measuring means.

[0007]

Function

According to the present invention, since the height of the securing member is adjusted through the adjusting means on the basis of data from the measuring means, the parallelism between the probe card and the chuck

top is controlled with high precision, so that it is possible to make the inspection member and the terminal of the chip in contact with each other with an appropriate, evenly adjusted pressure.

[0008]

Embodiment of the Present Invention

Embodiment 1

Referring to Figs. 1 to 5, the following description will discuss one embodiment of the present invention. Here, those members which are the same as, or identical to those of the conventional example shown in Fig. 7 are indicated by the same reference numerals, and the description thereof is omitted. Fig. 1 is a schematic block diagram which shows a prober device in accordance with the present invention. In this Figure, reference numeral 21 represents a laser oscillator, 22 and 23 represent half mirrors, 24 and 26 represent total reflection mirrors, and 25 represents a counter, and these members constitute a measuring means which measures the parallelism of the probe card 1 with respect to the chuck top 7. Three sets of the above-mentioned members are attached to the chuck top 7 in a manner so as to form a triangle. Reference numeral 27 is a taper pin which is used for adjusting the height of the prober reference washer 3 serving as a securing member, and 28 is a stepping motor for driving the taper pin 27, and these members constitute an adjusting means for adjusting the above-mentioned parallelism. In the same manner as the above-mentioned measuring means, three sets of these adjusting means support the reference washer 3 so as to adjust the height. Reference numeral 29 represents control means which measures the distance between the chuck top 7 and the probe card 1 based

upon information from the three counters 25 to calculate the tilt thereof, and sends correction data to the motor 28 so as to drive the above-mentioned adjusting means. Fig. 2 is a layout in which the chuck top 7 is viewed from the probe card 1 side. Fig. 3 is a layout of the probe card 1 viewed from the chuck top 7 side. Reference numeral 26 represents total reflection mirrors which are attached to the probe card 1 in a round shape. Fig. 4 is a conceptual drawing which shows the positional relationship between the taper pin 27 and paths through which a laser beam is reciprocally transmitted. The respective taper pins are indicated by 27a, 27b and 27c. Fig. 5 is a flow chart which shows processes from the securing of the probe card 1 to the reference washer 3 to the completion of height adjustments by the reference washer 3.

[0009]

The following description will discuss operations of the device. In the prober having the above-mentioned arrangement, after the probe card 1 has been secured to the prober reference washer 3 with stopping screws 8, a pulse is transmitted only once from each of the three laser oscillators 21. The light beam is directed toward the total reflection mirror 26 through the half mirror 22. Thereafter, the light beam is reciprocally transmitted between the half mirrors 22 and 23 with the half mirrors 22, 23 being interpolated in between. At this time, one portion of the light beam is sent to the counter 25 each time it passes through the half mirror 23. By counting the number of times of reciprocal movements of this light beam within a fixed time, the control means 29 calculates the distance between the chuck top 7 and the probe card 1. At this time, the light comes to attenuate

every time it passes through the half mirrors 22, 23, with the result that, when the counter 25 has finally become incapable of detecting the light, the next light beam is transmitted immediately; therefore, the distance calculation is always carried out. If the parallelism of the three counters 25 is maintained with high precision, the count numbers of the three counters 25 become the same; however, if it is not maintained appropriately, deviations occur in the count numbers depending on the tilts thereof. The greater the count number at a point, the shorter the distance between the probe card 1 and the chuck top 7, while the smaller the count number at a point, the longer the distance between them at the point. Therefore, the correction data is sent to the stepping motor 28 to drive the taper pin 27 so as to provide the same count number; thus, the position of the reference washer 3 is adjusted. More specifically, the control means 29 finds the average value of the count numbers at two measuring points, and determines a point, b point and c point, starting with the point which has a count number closest to the average count number. First, by using a point as a reference point, the taper pin 27b is driven until the distance at b point has become the same as the distance at a point. When the count number is greater than that at a point, the driving process is carried out in a screwing direction into the reference washer 3, thereby raising the reference washer 3. In the opposite case, the driving process is carried out in a drawing direction from the reference washer, thereby lowering the reference washer 3. At this time, the line connecting a point and b point is made in parallel with the chuck top 7, and the taper pin 27c is then driven so as to make the distance at c point the same as that of the other two points; thus, the count numbers of all the

counters 25 are set to the same value. The above-mentioned sequence of operations adjust the probe card 1 to be in parallel with the chuck top 7; thus, it becomes possible to obtain an appropriate, even contact pressure between the probe stylus 2 and the bonding pads 6a, 6b.

[0010]

Embodiment 2

In the above-mentioned embodiment, with respect to the measuring means for measuring the distance between the prober 1 and the chuck top 7 at three points to find the tilt, the means having the laser oscillator 21, half mirrors 22, 23, total reflection mirrors 24, 26 and count counters 25 is used; however, instead of this means, as shown in Fig. 6, a capacity sensor 30 for measuring the electrical capacity may be used.

[0011]

Effects of the Invention

As described above, in accordance with the present invention, since the prober device is provided with adjusting means for adjusting parallelism of the probe card with respect to the chuck top, measuring means for measuring the parallelism, and control means for driving the adjusting means based upon an output of the measuring means, it is possible to easily obtain an appropriate, even contact pressure between the inspection member, such as a probe stylus and an electrode, and the chip terminal, and consequently to provide a longer service life in the device.

Brief Description of the Drawings

Fig. 1 is a schematic block diagram which shows a prober device in accordance with one embodiment of this invention.

Fig. 2 is a layout of a chuck top viewed from above in accordance with the embodiment of the invention.

Fig. 3 is a layout of a probe card viewed from below in accordance with the embodiment of the invention.

Fig. 4 is a drawing which shows the positional relationship between a taper pin and reciprocal paths of a laser beam in accordance with the embodiment of the invention.

Fig. 5 is a flow chart which shows a sequence of operations in accordance with the embodiment of the invention.

Fig. 6 is a schematic block diagram which shows a prober device in accordance with another embodiment of this invention.

Fig. 7 is a schematic perspective view (one portion of which is a cross-sectional view) which shows a structure of a conventional prober device.

Fig. 8 is a drawing which shows a contact state between a probe stylus and a bonding pad.

Fig. 9 is a cross-sectional view which shows one type of probe card without a probe stylus.

Reference Symbols

1: probe card

2: probe stylus (inspection member)

3: prober reference washer (securing member)

4: wafer

5, 5a, 5b: chip

6, 6a, 6b: bonding pad (chip terminal)

7: chunk top

8: screw

9: electrode (inspection member)

21: laser oscillator

22: half mirror

23: half mirror

24: total reflection mirror

25: counter

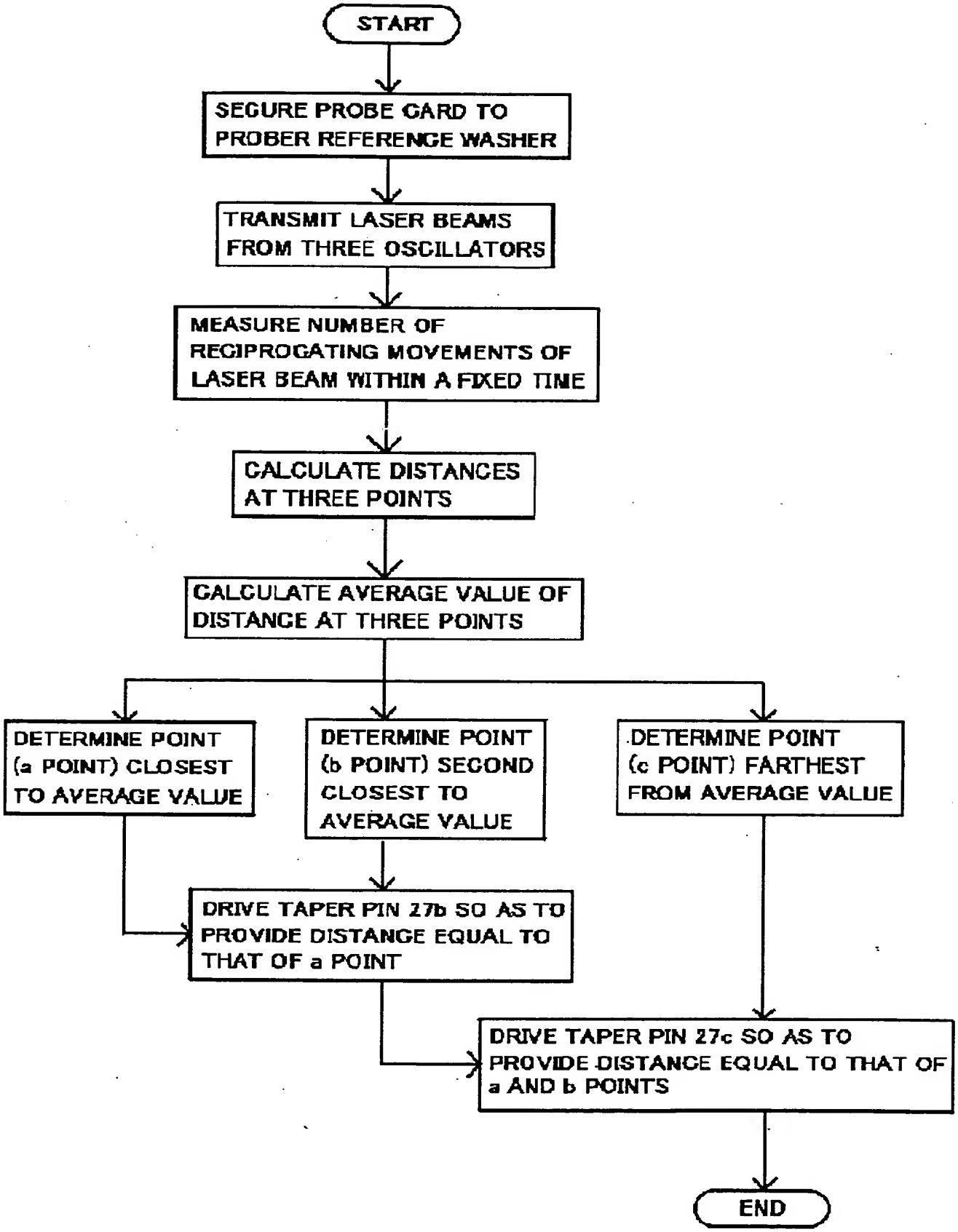
26: round-shaped total reflection mirror

27, 27a, 27b, 27c: taper pin

28: stepping motor

29: control means

30: capacity sensor


START
SEGURE PROBE CARD TO PROBER REFERENCE WASHER
TRANSMIT LASER BEAMS FROM THREE OSCILLATORS
MEASURE NUMBER OF REGIPROCATING MOVEMENTS OF LASER BEAM WITHIN A FIXED TIME
CALCULATE DISTANCES AT THREE POINTS
CALCULATE AVERAGE VALUE OF DISTANCE AT THREE POINTS
DETERMINE POINT (a POINT) CLOSEST TO AVERAGE VALUE
DETERMINE POINT (b POINT) SECOND CLOSEST TO AVERAGE VALUE
DETERMINE POINT (c POINT) FARTHEST FROM AVERAGE VALUE
DRIVE TAPER PIN 27b SO AS TO PROVIDE DISTANGE EQUAL TO THAT OF a POINT
DRIVE TAPER PIN 27c SO AS TO PROVIDE DISTANCE EQUAL TO THAT OF a AND b POINTS
END

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Amendment

Date of Submission

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Amendment 1

Document Name of Object of Amendment

Specification

Item Name of Object of Amendment

Claim

Method of Amendment

Change

Contents of Amendment

Claim

1. A prober device comprising:

a chuck top, where a wafer on which a chip containing integrated semiconductor element is formed is mounted on an upper surface thereof, capable of shifting three dimensionally;

a probe card which is placed above the chuck top;

an inspection member which is placed on the lower surface of the probe card and which brings in contact with a terminal of the chip to test the chip when the chuck top is elevated; and

a securing member which secures the probe card through screws, wherein

the prober device further comprises:

adjusting means for adjusting parallelism of the probe card with respect to the chuck top;

measuring means for measuring the parallelism by finding a distance between the probe card and chuck top on the basis of attenuation of

laser light; and

control means for driving the adjusting means on the basis of an output of the measuring means.

Amendment 2

Document Name of Object of Amendment

Specification

Item Name of Object of Amendment

0006

Method of Amendment

Change

Contents of Amendment

[0006]

A prober device according to the present invention comprises: a chuck top, where a wafer on which a chip containing integrated semiconductor element is formed is mounted on an upper surface thereof, capable of shifting three dimensionally; a probe card which is placed above the chuck top; an inspection member (probe stylus 2, electrode 9) which is placed on the lower surface of the probe card and which brings in contact with a terminal (bonding pads 6a, 6b) of the chip to test the chip when the chuck top is elevated; and a securing member (prober reference washer 3) which secures the probe card through screws, wherein the prober device further comprises: adjusting means for adjusting parallelism of the probe card with respect to the chuck top; measuring means for measuring the parallelism by finding a distance between the probe card and chuck top on the basis of attenuation of laser light; and control means for driving the adjusting means on the basis of

an output of the measuring means.

Amendment 3

Document Name of Object of Amendment

Specification

Item Name of Object of Amendment

0007

Method of Amendment

Change

Contents of Amendment

[0007]

Function

According to the present invention, since the height of the securing member is adjusted through the adjusting means on he basis of data from the measuring means which finds a distance on the basis of attenuation of laser light, the parallelism between the probe card and the chuck top is controlled with high precision so that it is possible to make the inspection member and the terminal of the chip in contact with each other with an appropriate, evenly adjusted pressure.

Amendment 4

Document Name of Object of Amendment

Specification

Item Name of Object of Amendment

0011

Method of Amendment

Change

Contents of Amendment

[0011]

Effects of the Invention

As described above, in accordance with the present invention, since the prober device is provided with adjusting means for adjusting parallelism of the probe card with respect to the chuck top, measuring means for measuring the parallelism by finding a distance between the probe card and chuck top on the basis of attenuation of laser light, and control means for driving the adjusting means on the basis of an output of the measuring means, it is possible to easily obtain an appropriate, even contact pressure between the inspection member, such as a probe stylus and an electrode, and the chip terminal, and consequently to provide a longer service life in the device.